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MW1 C STATION TRAINING AND INCIDENT CASE STUDIES

FILE NO. 2024 /02.

MILPERRA 6th ALARM TIMBER JOINERY FIRE



"Learning from Excellence... To Protect the Irreplaceable."



Cover Picture: Firefighters battle intense fire activity within the timber yard.

Incident Video



(Control + Click on YouTube symbols to watch). Thanks to 7 News helicopter

Incident Summary:

Firefighters were called to a fire that had broken out within a timber yard and joinery used for the manufacture of timber pallets and crates. The timber yard was being impacted by 30 km/h winds that were gusting to 50 km/h and was rapidly taking hold. When firefighters arrived on scene, fire was burning with fierce intensity. Heavy flames driven by strong winds were impacting adjoining Exposure Bravo, an engineering factory, placing it in immediate danger. Although the initial strategy for achieving fire control was to attack the fire with an elevated aerial master stream, the I.C. immediately recognised Exposure Bravo was under significant threat and tasked firefighters to protect the threatened exposure as a matter of priority. The fire was burning rapidly through the timber stacks, expanding and increasing intensity. Driven by strong winds and fuelled by large quantities of timber and other hydrocarbon-based materials, the fire was burning fiercely and producing increasingly large quantities of radiant heat. Fire conditions were intense and a number of gas cylinder explosions occurred.

A key strategy of the I.C. was to commence an aerial master stream attack on the fire as soon as possible to reduce fire intensity, with the intention of gaining fire control. The I.C. tasked incoming stations to immediately commence establishing a water supply, that would allow the CAP 47 aerial appliance to attack the fire with an effective aerial stream. In a coordinated operation, water supply to the aerial was rapidly established, enabling firefighters to commence attacking the most intense parts of the fire with the aerial stream. Exposures under immediate threat included a large warehouse heavily stocked with vinyl cladding and a rental car yard containing almost 80 vehicles. These exposures were located in close proximity to the timber yard and were directly in the path of the expanding fire.

Continuous size-up enabled the I.C. to identify incident priorities and deploy resources in accordance with incident needs. As additional stations arrived on scene, firefighters began to increase and strengthen protection of threatened exposures. SCBA crews advanced fire attack lines into the involved timber yard, establishing cut-off lines that effectively contained and halted the spreading fire. Firefighters removed multiple gas cylinders from the fire's path. In a coordinated operation, aerial appliances conducted a direct attack on the fire, reducing the fire intensity and simultaneously directed protective aerial streams along the boundaries of heavily threatened exposures. Firefighters used hose lines to establish protection of exposures and gained entry into threatened buildings, extinguishing outbreaks of fire before they could take hold. Firefighters worked under arduous and severe fire conditions to gain fire control, establish fire containment and protect multiple exposures under significant threat. Fireground command was exemplary. Firefighting was conducted with strong determination, discipline and professionalism. Under severe fire conditions, the best possible incident outcomes were achieved. There are many positive lessons to be shared from firefighting operations at this fire.

Key Learning Points: 1. Critical Importance of Establishing and Prioritising Water Supply. 2. Tactical Fireground Decision Making. 3. Fires Involving Timber Yards. 4. Exposure Protection. 5. Wind Driven Fires. 6. LPG Cylinders Involved in Fire.

Incident Type: Timber and Joinery Fire.

Station Training Program References:

- STP Drill 1 Flammable Liquids and Gases
- STP Drill 2 Special Fires (Bulk Storage, Dust, Cladding, Plastics, Metal, and Rubber Fires)
- STP Drill 4 Psychological Preparedness
- STP Drill 5 Physical Preparedness
- STP Drill 6 Personal Safety and Risk Management
- STP Drill 7 Pumps/Pumping Operations
- STP Drill 8 Operational Entry and Use of Hoses and Branches
- STP Drill 13 Fire Behaviour
- STP Drill 15 Salvage and Overhaul
- STP Drill 16 Incident Management
- STP Drill 17 Incident Communications
- STP Drill 22 Hazardous Atmospheres Self Contained Breathing Apparatus
- STP Drill 32 Electricity and Fire Involving Electrical Hazards
- STP Drill 33 Methods of Construction and Structural Collapse

Abbreviations/Acronyms Used in this Report:

BA – Breathing Apparatus. BLEVE – Boiling Liquid Expanding Vapour Explosion. CAFS - Compressed Air Foam System. CAN - Conditions Actions Needs report. EPA – Environmental Protection Authority. FireComs – FRNSW Fire Communications. FRNSW – Fire and Rescue NSW. IC – Incident Commander. LPG – Liquefied Petroleum Gas. MDT- Mobile Data Terminal. MFO – Main Fire Occupancy. RPAS - Remotely Piloted Aerial System. SAR - Search and Rescue. SCBA – Self Contained Breathing Apparatus. SFF – Senior Firefighter. SO - Station Officer. TIC – Thermal Imaging Camera.

Relevant Definitions Used in this Report:

<u>Fire brigade booster assembly:</u> Terminology used within AS 2419.1 to describe the booster fitting and installed equipment used by firefighters to increase pressure and flow within the installed fire main.

Time, Date and Place of Call:

1744 hours on Tuesday 21st December 2023, 2 Woorang Street, Milperra.

FRNSW Response:

CAFS Aerial Pumper 47 (Revesby), Pumpers 34 (Riverwood), 52 (Campsie), 90 (Menai), 73 (Yennora), 29 (Arncliffe), 84 (Macquarie Fields), 49 (Cabramatta), 22 (Leichhardt), 35 (Botany) and 16 (Concord), Rescue Pumper 62 (Bankstown), Hazmat Pumper 85 (Chester Hill), Heavy Hazmat 85, CAFS Pumpers 30 (Lidcombe), 31 (Busby) and 64 (Lakemba), Technical Rescue 8 (Liverpool), Ladder Platforms 21 (Kogarah) and 27 (Parramatta) Mobile Command Centre Bravo, Logistics Support Vehicle 1 (City of Sydney), Rehabilitation Pod 1 and Duty Commanders ME3 (Inner West) and MW2 (Parramatta).

In addition to the above response, a further 10 appliances and 14 specialists and senior officers attended the fireground for fire duty and relief purposes.

Additional Agencies/Services in Attendance:

NSW Police Force, NSW Ambulance, Electricity Authority, Traffic Management Centre, local council and Environmental Protection Authority.

Fireground Description:

The fireground was a timber yard and joinery known as "*N* & *D* Fisher Pallet Manufacturers" engaged in the manufacture of timber pallets and crates. The Main Fire Occupancy (MFO) consisted of a yard 50 m x 30 m. Two small offices, each being 3.5 m x 7.0 m were located at the front of the yard near the Alpha side. Areas of timber storage were located within the forward half of the yard, containing hard and soft wood (pine), stored in stacks. Industrial machinery associated with the business, largely consisting of joinery and woodworking machines were located within the rear half of the yard. A mechanical workshop was located at the Charlie/Delta corner of the site. Numerous containers of assorted lubricants, cleaning products, degreasers, aerosols, fuels and other hydrocarbon-based products were located throughout the site to support the operation of the site machinery. A flammable gas cylinder storage cage was located to the east of the office buildings. Two LPG powered forklifts were located in the middle of the yard.

The site contained two overhead crane gantries, extending from the front to rear of the site, located on the Bravo and Delta sides of the site. The cranes were no longer operational. Each crane gantry was located above an area 10 m x 30 m. The gantries were formed from prefabricated steel, 400 mm (web) and 150 mm (flange) secured with rivets. The crane gantries were supported by prefabricated steel columns 4.0 m high. 1.5 m extensions above the crane gantries were used to support sections of roof above parts of the yard. The Charlie side of the yard had a covering formed from iron sheets above an area 30 m x 30 m. The middle of the yard was covered by iron sheets above an area 15 m x 12 m. The iron sheets were fixed to timber battens, attached to the 1.5 m steel extensions attached to the top of the crane gantries. There were no walls or cladding attached to the yard. Two vehicle double gates were located at the front of the yard, on the Bravo and Charlie sides of the yard.

Exposure Bravo consisted of an engineering workshop, located in a two-level building 30 m x 15 m, formed from pre-cast concrete tilt slab panels (180 mm wide), steel frame and metal clip-lock roof. There was no separation between the MFO and Exposure Bravo.

Exposure Charlie was a warehouse containing vinyl cladding. The warehouse was heavily stocked. The building was 50.0 m x 25.0 m, single level, brick clad, steel frame and fitted with an iron sheet roof. Exposure Charlie was located 1.0 metres to the east of the MFO.

Exposure Delta was a car rental yard, occupying an area 50 m x 30 m. A workshop and office 10 m x 15 m, was located on the northern side of the site. The yard was at capacity, containing almost 80 vehicles. Exposure Delta was separated from the MFO by a 4.5 m high fence formed from galvanised steel panels.

Fireground Installed Firefighting Systems:

The site contained one 8 kg dry chemical (ABE) handheld portable extinguisher. The site did not contain any other installed firefighting systems or equipment.

The following hydrant supplies were located near the fireground:

-A 150 mm diameter water main was located on the northern side of Milperra Road.

-A 150 mm diameter water main was located on the southern side of Milperra Road.

-A 100 mm diameter water main was located on the eastern side of Woorang Street (a deadend main).

-A 100mm fire main was located on the western side of Woorang Street, servicing the Pickles Auction site. An above ground twin headed attack hydrant attached to this fire main was located opposite 10 Woorang Street.

-A 150 mm main was located in Marigold Street (on the southern side of Milperra Road).
-A 100 mm fire main and attached fire brigade booster assembly (consisting of two supply hydrants) was located at the front of the Exposure Charlie site.

Weather at Time of Call:

Temperature 22.3°C (apparent 17.3°C), relative humidity 53%, **Winds south at 30 km/h**, **gusting to 48 km/h**, nil rain, cloud 7/8 and mean sea level pressure 1006.7 hPa recorded at Bureau of Meteorology Bankstown Airport automatic weather station (approximately 1.5 km from the fireground). The following wind readings were recorded:

1830 hours south south-west 30 km/h gusting to 46 km/h 1900 hours south 28 km/h gusting to 39 km/h 1920 hours south 28 km/h gusting to 50 km/h

Situation Prior to FRNSW Arriving on Scene:

The business had been in operation on the day of the fire, engaged in normal operations. At approximately 1600 hours the four workers present at the site ceased operations for the day, switched off all machines, locked the site front gates and left the site. Nothing unusual was noted at the site until 1744 hours, when passers-by first noticed smoke issuing from the site.



Fireground Drawing Not to Scale

Fire Behaviour Considerations

The following fire behaviour considerations are of note:

1. Within a short time of the fire starting, fire spread to finished timber pallets and crates in the storage yard.

2. Timber pallets and crates have a high surface area to mass ratio, exposing larger areas of fuel load to air, increasing the level of fire intensity and combustion.

3. The typical storage arrangements for pallets and crates (i.e. stacked on top of each other) provides significant aeration, increasing oxygen supplies to the combustion zone resulting in increased fire intensity.

4. The typical storage arrangements of timber pallets and crates facilitate the formation of a drafting effect, drawing air vertically through the stacks and increasing the rate of fire spread. The storage arrangement facilitated accelerated vertical fire spread, due to very rapid flame propagation.

5. The softwood pine used in the construction of the pallets and crates has a heat release rate of 45 kWm².

Initial Call and Response:

At 1744 hours on Tuesday 21st December 2023, FRNSW Fire Communications received a report of a possible "building fire" at 2 Woorang Street, Milperra. CAFS Aerial Pumper 47 and Pumper 34 were initially assigned to the call. A short time later, Fire Communications began to receive additional '000' calls reporting a fire involving a timber yard at the call address, resulting in the response being increased to a Structure Fire 2nd Alarm. CAFS Pumpers 31 and 64, Rescue Pumper 62, Ladder Platform 21 and Duty Commander ME3 (Inner West) Inspector Graeme Moore were additionally assigned to the fire.

CAFS Aerial Pumper 47, under the command of Station Officer Martin Quigg, was one of the initial appliances to be responded to the fire. S.O. Quigg noted that as CAFS Aerial Pumper 47 responded to the fire, a number of breakthrough messages were sent to the appliance Mobile Data Terminal, including information that numerous calls were being taken and confirmation a timber yard was alight. Responding firefighters observed the number of appliances being increased on the MDT. As CAFS Aerial Pumper 47 turned onto Milperra Road, firefighters could see a smoke plume in the distance. Pumper 34, under the command of S.O. Greg Nolan, was crossing the high point of the railway bridge at Riverwood, when firefighters could see a smoke column in the direction of the reported fire in the distance.

First Crews Arrive on Scene:

As CAFS Aerial Pumper 47 approached the reported fire address, smoke was blowing horizontally, from the fire. A strong wind was blowing, causing the smoke plume to be blown sideways. At the time the wind strength was 30 km/h and gusting to 48 km/h. The prevailing winds restricted the establishment of a vertical smoke column from the fire, which was not giving a true indication of the size and intensity of the fire. CAP47 turned into Woorang Street, arriving on scene. S.O. Quigg made the following initial observations of the fire:

"On approach, the size of the fire wasn't immediately obvious. A strong wind was pushing the smoke column sideways. As we got closer, we could see heavy fire inside the timber yard. On arrival, I could see a lot of fire. The middle area of the yard, stacked with timber, was well alight. The wind was pushing the fire. Large flames were being driven towards Bravo Exposure, an engineering factory, which was under immediate threat. My first priority was to try and protect Bravo Exposure. I later discovered the exposure was constructed with concrete tilt slab walls, however at that time large volumes of heavy smoke were obscuring the view of this factory."

At 1752 hours S.O. Quigg sent the following RED CAN report:

"FIRE COMS CAP 47 RED! RED! RED! FROM 2 WOORANG STREET, MILPERRA, WE HAVE A WORKING FIRE. FIRE INVOLVES A TIMBER YARD AND MACHINERY WORKSHOP LOCATED BENEATH A CORRUGATED IRON ROOF COVERING. PREMISES IS LOCKED UP. THE FIRE IS BEING DRIVEN BY A STRONG SOUTHERLY WIND. THERE ARE NUMEROUS EXPOSURES, INCLUDING A CAR HIRE YARD AND A FACTORY OF UNKNOWN DIMENSIONS UNDER THREAT. REQUEST A STRUCTURE FIRE 3RD ALARM. REQUIRE POLICE, AMBULANCE AND ELECTRICITY. S.O. 47 IS I.C. FURTHER MESSAGE TO FOLLOW, OVER."



When firefighters first arrived on scene, they found the middle of the timber yard burning fiercely.

Fire Behaviour Considerations

The following fire behaviour considerations are of note:

1. All sides of the main fire occupancy were open, allowing the entry of any prevailing winds.

2. At the time of call, the wind was blowing from the south at 30 km/h gusting to 48 km/h.

3. The combination of the open sided yard and prevailing winds allowed additional oxygen supplies to enter the fire area, resulting in significantly increased fire activity, including high heat release rates (radiant heat), increased rates of spread, increased flame intensity and the production of increased quantities of smoke.

4. A narrower opening existed on the Charlie/Delta (upwind) side of the main fire occupancy and a much wider opening existed on the Alpha/Bravo (downwind) side of the main fire occupancy, beneath the iron sheet roof, allowing a "venturi" to form inside the main fire occupancy, causing accelerated airflow at the fire combustion zone, increasing fire intensity further.

5. The involvement of large quantities of volatile and flammable materials (assorted lubricants, cleaning products, degreasers, aerosols, fuels and other hydrocarbon-based products) located within the fire combustion area resulted in the release of extremely flammable "supercharged" hydrocarbon-rich pyrolysis gases that rapidly ignited, producing fierce fire conditions.

6. At the wind entry point on the Charlie/Delta (upwind) side of the main fire occupancy, there was almost no sign of venting flame. To the contrary, at the fire vent outlet, on the Alpha/Bravo (downwind) side of the main fire occupancy, large flames vented horizontally. Aerial video taken by a media helicopter shows flames at least 15 metres long venting on the downwind side of the main fire occupancy.

7. Essentially, the Main Fire Occupancy was experiencing a wind driven fire, resulting in extreme fire conditions.

8. In addition to the hydrocarbon-based fuel loads present, a large amount of heat was being generated from the involvement of the stacked timbers present, particularly the pine soft woods.

Initial Firefighting Operations:

S.O. Quigg realised that due to the large size of the fire, the most effective means of attack would be with the aerial master stream from CAP 47. He also realised that it would take time to establish the necessary water supply for the aerial to enable it operate effectively. Exposure Bravo was in immediate danger and the first priority of S.O. Quigg was to try and stop the fire spreading to this exposure. Exposure Bravo was a two-level engineering factory, which was being heavily impacted by fierce wind driven flames. Winds were gusting to almost 50 km/h, driving the smoke column and flames sideways, across the face of Exposure Bravo and preventing firefighters from identifying the concrete slab construction of this building. Despite the higher levels of fire-resistant construction, the second level frontage of the Exposure Bravo building was completely formed of glass, which was now being heavily impacted by venting flames. S.O. Quigg's initial concern was that failure of the glass frontage would allow fire to breach into Exposure Bravo, resulting in fire involvement of the factory, ultimately leading to a doubling of the size of the fire. S.O. Quigg liaised with Police and requested eastbound lanes of Milperra Road be closed. Police immediately put these road closures in place. Fire conditions in the timber yard were ferocious, fierce flames were being driven by the wind in a northerly direction and within the yard, fire was spreading uncontrollably in all directions.

Pumper 34, under the command of S.O. Greg Nolan arrived on scene a short time after CAP 47. The I.C. tasked S.O. Nolan to commence protection of the glass frontage of Exposure Bravo and designated S.O. Nolan Bravo Sector Commander. S.O. Nolan made the following observations of the fire situation:

"As we were arriving, our initial concerns were that the cars in Exposure Delta were possibly under threat. However, once we entered Woorang Street and drove past CAP 47, we could see Exposure Bravo was being heavily impacted by fire. The wind was driving heavy fire into Exposure Bravo."

At 1757 hours, the I.C. sent the following CAN report:

"FIRE COMS CAP 47 BLUE. WE HAVE HEAVY FIRE IMPACT TO THE BRAVO EXPOSURE, AN ENGINEERING BUSINESS. PUMPER 34 IS SETTING UP LINES TO PROTECT THIS EXPOSURE. THIS INCIDENT WILL BE KNOWN AS MILPERRA COMMAND, OVER."

The Exposure Bravo factory was being heavily impacted by fire and was in imminent danger. Pumper 34 firefighters initially entered the Exposure Bravo site, ensuring all persons had evacuated from the factory. When it was established no persons remained in Exposure Bravo, this information was passed to the I.C. and an "*All-Clear*" was declared for Exposure Bravo. Electricity to Exposure Bravo was switched off, however S.O. Nolan was concerned there were still live DC circuits in the building because of the large solar panel array on the building roof. Pumper 34 and CAP 47 firefighters placed a 70 mm single inlet monitor at the front of the involved timber yard and attempted to direct a protection stream onto the wall of Exposure Bravo. The angle of projection from the street footpath was obstructed by a number of obstacles, including timber stacks, a truck inside the yard and the fence, reducing the effectiveness of the monitor stream. CAP 47 firefighters cut the padlocked gates on the northern side of the Alpha Side entrance to gain access to the timber yard. This enabled Pumper 34 firefighters to reposition the single inlet monitor inside the front of the yard to achieve a more effective protective stream onto the Exposure Bravo southern wall.

Fire impact was so fierce, that post fire examinations would reveal severe concrete spalling due to the intense nature of fire impact. The cooling stream from the single inlet monitor was having a significant impact protecting this exposure. Venting flames continued to heavily impact the second level glass frontage of Exposure Bravo. Firefighters used a 70 mm protection line to direct a cooling stream onto the glass frontage, providing sufficient protection to prevent the glass from failing.

Firefighters obtained water supplies for Pumper 34 via two 70 mm collector lines from the twin headed attack hydrant outside the Pickles Auction storage warehouse on Woorang Street. Water supply was being boosted by the on-site pump and S.O. Nolan reported water pressure was excellent.

Water Supply Established for Aerial Attack:

The I.C. was aware Pumper 34 firefighters protecting Exposure Bravo were obtaining water supplies from Woorang Street. Although the Pumper 34 collector lines were connected to attack hydrants attached to the Pickles Auction fire main, water for this fire main was being drawn from the 100 mm Woorang Street main. Additionally, the Woorang Street main was a "dead end" main therefore water supply was diminished. S.O. Quigg advised he did not want to use Woorang Street hydrants to supply CAP 47 because this would divert water already going to Pumper 34, causing them to suffer reduced supplies (and most likely experience water over-run), which would critically affect their ability to protect Exposure Bravo. Instead, the I.C. made the decision from the outset to establish a water relay from the Milperra Road 150 mm main to supply CAP 47. Aware that there were numerous appliances inbound to the fireground and realising the necessity of establishing a water supply for CAP 47, S.O. Quigg sent a message directing all incoming appliances to remain on Milperra Road and not enter Woorang Street, to facilitate establishment of a water relay for CAP 47.

S.O. Quigg realised the most effective means to attack the fire would be with the largest possible aerial master stream, providing the hardest hitting jet. To achieve this, CAP 47 would need the largest water supply possible, from four 70 mm supply lines. CAFS Pumpers 31 and 64, Pumper 52 and Rescue Pumper 62 arrived on Milperra Road. The I.C. informed these crews he needed to establish a water supply for CAP 47 from the Milperra Road main as a matter of urgency. The crew of CAFS Aerial Pumper 47 fitted the aerial monitor with stacked tips and the aerial cage was elevated and prepared to commence operations. Rescue Pumper 62 firefighters located the first hydrant on Milperra Road to the east of Woorang Street and laid two 70 mm collector lines to CAP 47, enabling the aerial to commence operating. At 1810 hours, the I.C. sent the following CAN report:

"FIRE COMS CAP 47 MILPERRA BLUE. WE HAVE A TIMBER YARD WELL ALIGHT. THE FIRE IS PRODUCING LARGE VOLUMES OF SMOKE BLOWING IN THE DIRECTION OF BANKSTOWN AIRPORT WHICH IS NEARBY. REQUEST BANKSTOWN AIRPORT BE INFORMED OF THE FIRE. WE CURRENTLY HAVE MULTIPLE LINES OF 70 AND 38 MM LINES AND A GROUND MONITOR AT WORK. GETTING CAP TO WORK. WE HAVE A WATER SUPPLY COMING IN FROM MILPERRA ROAD, OVER."

On the western side of Woorang Street, firefighters located a hydrant on the Milperra Road main near the intersection of Cooraban Road. Two 70 mm lines were laid from the standpipe to intermediate relay appliance Pumper 52. Two lines were laid from Pumper 52 to CAP 47, providing the aerial with four 70 mm supply lines. An additional two 70 mm supply lines were laid from a hydrant on Marigold Street (150 mm main) to Pumper 52. Water from the Marigold Street main supplemented the water supply to Pumper 52 and ensured the water supply within the Milperra Road main was not in danger of being over-run. To enable hose lines to be laid across Milperra Road it became necessary for Police to close westbound lanes on Milperra Road. These road closures were effected very quickly by Police, ensuring the safety of firefighters working on the roadway and ensuring security of the water supply.

All firefighters establishing the water relays realised the critical importance of establishing a water supply for CAP 47 as quickly as possible. Firefighters protecting Exposure Bravo were barely holding the fire as winds gusting up to 50 km/h continued to drive the fire towards the exposure. Firefighters urgently needed to commence operations with the aerial master stream in an attempt to reduce the fire's intensity and stop the fire's progression. Firefighters establishing the water relays worked as quickly as they could; the three separate water relays going into CAP 47 were operating within 10 minutes of firefighters commencing to set up the relays.

Aerial Master Stream Attack:

The crew of CAFS Pumper 47 were operating the aerial monitor fitted to the working cage remotely from the ground. The aerial monitor was fitted with stack tips, providing firefighters with a number of advantages; the stack tips produced a solid core jet, enabling water to be projected a greater distance. The aerial stream was less susceptible to the impact of wind and remained intact over a greater distance. The solid core stream was able to penetrate with greater depth into the fire. The CAFS Pumper 47 operators alternated the aerial master stream between direct fire attack on the burning timber and protection of exposures Bravo and Delta. Although firefighters were encountering fierce conditions due to the combination of a high fuel load and severe wind impact, the precisely directed aerial stream had a significant impact, reducing fire intensity and providing effective cooling of exposure boundaries.

Protection of Exposure Delta:

Operations had been established and were working effectively to protect Exposure Bravo. The next exposure potentially under threat was Exposure Delta. Although the fire was being heavily driven by the wind in a northerly direction towards Exposure Bravo, the fire was burning back against the wind in a southerly direction through timber stacks and other materials towards the Exposure Delta car rental yard (containing almost 80 vehicles). The I.C.'s objective was to pre-emptively establish protection of Exposure Delta before the fire reached the exposure, to minimise fire spread into the exposure, rather than reactively have to deal with an uncontrollable escalation in fire spread.

The I.C. appointed Pumper 52 S.O. Tim Blanch Delta Sector Commander. The crew of Technical Rescue 8 were tasked to force the gates to Exposure Delta and then gain entry to the office/workshop building within the Exposure Delta site and open all doors for the deployment of fire attack lines if necessary. The crew of Technical Rescue 8 gained access to the car yard by cutting through the steel gates with a power saw. Firefighters then cut through the roller door of the garage and opened all doors, increasing access to the building in the event fire conditions escalated, enabling the rapid placement of fire attack lines. Fire from the timber yard was beginning to impact the roof eaves and enter the roof space of Exposure Delta. The crew of Technical Rescue 8, wearing SCBA, used a high-pressure car wash mist spray to extinguish this fire. Firefighters continued to direct the high-pressure mist spray onto areas of the wall where elevated temperatures were detected, preventing fire from entering the building. Technical Rescue 8 firefighters were assisted by an SCBA crew from CAFS Pumper 31.

Pumper 90, under the command of S.O. Paul Ferguson, were tasked to assist protection of Exposure Delta. Firefighters obtained a water supply for Pumper 90 from the Milperra Road main. A 38 mm protection line was laid from Pumper 90 through the eastern side of the yard, which was being heavily impacted by fire burning within the timber stacks in the yard. S.O. Ferguson made the following observations of the fire behaviour at his location:

"The fire was burning up against the steel Colorbond fence. The steel panels were glowing in places from the intensity of fire impact. The heat was severe. The cars were only 300 mm from the fence and were packed tightly into the yard, making access difficult. We used a 38 mm line to continually cool the fence. Fire spread into the roof eaves of the office and workshop. Working in conjunction with the internal firefighting crews, we extinguished this fire with our 38 mm line. Again, access was difficult because of the tightly parked cars. We remained in position and continued to direct cooling streams onto the steel fence, stopping the fire from spreading into the yard."

Collapse Exclusion Zone Established:

Pumper 49 firefighters were tasked to continue protection of Exposure Bravo. Firefighters entered Exposure Bravo to check for fire spread and discovered possible movement of precast concrete tilt slabs forming the building wall near the Charlie/Delta of Exposure Bravo. This information was relayed to the I.C. and a collapse exclusion zone was established within an area of the main fire occupancy in proximity to the potentially unstable wall panels. A request was made for Technical Rescue 8 firefighters to deploy the *Leader Sentry* stability/movement monitor, however the presence of the smoke plume significantly interfered with the operation of this equipment, preventing its use. As the incident progressed, the FRNSW Remotely Piloted Aerial System (RPAS) was deployed to the scene and was able to obtain aerial video of the wall which was relayed to structural engineers who confirmed the requirement for the collapse exclusion zone to remain in place.

Direct Attack on Timber Yard:

Rescue Pumper 62 S.O. Roslyn Bailey was appointed Alpha Sector Commander by the I.C. Rescue Pumper 62 firefighters cut the padlocked gates on the southern side of the Alpha Side entrance, allowing access to be gained to the Delta side of the timber yard. The fire was burning towards uninvolved timber stacks on the Delta side of the yard, located in close proximity to Exposure Delta. The objective for firefighters was to cut the fire off before it reached the uninvolved stacks, creating a buffer zone to stop it from spreading to Exposure Delta.

Rescue Pumper 62 firefighters wearing SCBA began to advance a 38 mm attack line from Pumper 34 into the yard through the southern entrance and commenced to wet down the uninvolved stacks of timber, reducing the ignitability of the timber. The Rescue Pumper 62 fire attack crew were also extinguishing spot fires burning around buildings inside the site and were directing attack streams onto the burning timber stacks.

Pumper 34 firefighters wearing SCBA were operating a separate 38 mm attack line located to the rear of the Rescue Pumper 62 fire attack crew, ensuring the escape route of the Rescue Pumper 62 remained clear as the Rescue Pumper 62 firefighters advanced deeper into the timber yard. Pumper 34 was now pumping water to two 70 mm and two 38 mm lines. All firefighters reported water supply was excellent.

Firefighters could hear a number of gas cylinders venting loudly. A short time later two explosions involving gas cylinders occurred, involving LPG powered forklifts in the middle of the yard. The fire was spreading towards a cage containing forklift LPG cylinders. Using a 38 mm protection line, Rescue Pumper 62 firefighters removed these cylinders from the storage cage and repositioned them at a safe location outside the yard. Firefighters discovered a further three LPG cylinders and one acetylene cylinder in a concealed position behind the site office. These cylinders were also removed out of the fire's path and relocated to a safe location. Prior to removal, firefighters examined the temperatures of the external casings of the cylinders with a thermal imaging camera and observed readings of 30°C. The area the cylinders were removed from was subsequently the subject of heavy fire impact. These actions alone by firefighters prevented numerous very hazardous BLEVE (Boiling Liquid Expanding Vapour Explosion) events from occurring.

Rescue Pumper 62 firefighters continued to extinguish spot fires involving timber stacks and direct protective streams onto non-involved timber stacks under heavy threat. These operations assisted to protect Exposure Delta and also stopped the fire from increasing in size. The 38 mm handline being used by Rescue Pumper 62 was shut-down and replaced with a monitor stream.

At this time the rear half of the timber yard was heavily involved in fire. The iron sheeting above the rear half of the yard was progressively collapsing. Firefighters working from the Alpha side of the yard were successfully stopping the forward spread of the fire through timber stacks in the front half of the yard.

Fire Behaviour Considerations

The following fire behaviour considerations are of note:

1. Fires involving timber stacks have high heat release rates, resulting in the production of high levels of radiant heat.

2. Fuel loads in timber yards are normally quite high.

3. Although not immediately obvious, sections of the stacked timber are located on strips of wood creating vertical air gaps between the stacks, increasing aeration and increasing the surface area to mass ratio of the fuel load. This can result in increased fire spread and fire intensity.

4. Some of the timber was loosely stacked, increasing aeration and increasing the surface area to mass ratio of the fuel load. This can result in increased fire spread and fire intensity.

5. Burning timber stacks can be extremely slow and difficult to extinguish. When heat penetrates below the surface to the inner core of the timber, firefighting water will cool the surface of the timber, however heat will continue to be released from within the timber, causing re-ignition to occur (At temperatures exceeding 250°C, wood pyrolysis occurs, releasing combustible gases including carbon monoxide, methane and methanol. The presence of oxygen in the air causes combustion to occur).

Transfer of Command:

Duty Commander ME3 (Inner West) Inspector Graeme Moore arrived on scene. Following a handover briefing, command was transferred to Inspector Moore and S.O. Quigg appointed Operations Officer. During the handover briefing, S.O. Quigg informed Inspector Moore that although protection had been established for Bravo and Delta Exposures and fire attack was underway from Alpha Sector, Exposure Charlie remained unprotected.

A short time after Duty Commander ME3 took command of the incident, Duty Commander MW2 Inspector Craig Easy arrived on scene and was appointed Operations Officer. The fireground command structure was established as follows:

Incident Commander: Duty Commander ME3 Inspector Graeme Moore.
Operations Officer: Duty Commander MW2 Inspector Craig Easy.
Safety Officer: CAFS Pumper 31 S.O. Tanya Marshall.
Alpha Sector Commander: Rescue Pumper 62 S.O. Roslyn Bailey.
Bravo Sector Commander: Pumper 34 S.O. Greg Nolan
Charlie Sector Commander: CAFS Pumper 64 S.O. Peter Baker.
Delta Sector Commander: Pumper 52 S.O. Tim Blanch.

Protection of Charlie Exposure:

Although strong southerly winds were pushing the fire in a northerly direction, fire was burning against the wind direction beneath the iron sheet cover on the Charlie side of the yard. The fire was entering a workshop area near the Charlie/Delta corner of the yard and was beginning to involve quantities of flammable hydrocarbon-based materials stored in the workshop, including fuels, lubricants, cleaning products and degreasers, resulting in a significant increase in fire activity, including large flames, high heat release rates and increased volumes of smoke. Heavy fire was beginning to impact the brick wall of the Charlie exposure, a large fully stocked storage warehouse containing combustible vinyl cladding, which was now in immediate danger.

The Operations Officer, Inspector Easy, commenced to conduct a 360° size-up of the fireground and immediately identified Exposure Charlie was under significant threat. Inspector Easy made the following observations of the fire threat to Exposure Charlie:

"A one metre gap existed between the open sided timber yard and the Exposure Charlie warehouse, which was being protected by a brick wall. Fire was burning fiercely involving the timber products stored in the timber yard. The fire was producing high levels of heat. I was immediately concerned that fire would spread to the warehouse and instructed the crew of CAFS Pumper 64 to place a 70 mm protection line in operation between the timber yard and Exposure Charlie to protect the warehouse."

The I.C. tasked CAFS Pumper 64 S.O. Peter Baker Charlie Sector Commander and tasked S.O. Baker to commence protection of Exposure Charlie. CAFS Pumper 64 obtained a water supply via two 70 mm collector lines connected to the Fire Brigade booster assembly supply hydrants located at the front of Exposure Charlie. Firefighters attempted to place a 70 mm attack line in operation, however poor water supply prevented an effective stream from being produced. The 70 mm line was shut down and firefighters wearing SCBA advanced a 38 mm attack line to the one-metre-wide gap located between the main fire occupancy and the western wall of Exposure Charlie. Firefighters then directed a protective cooling stream onto the Exposure Charlie wall.

The Operations Officer requested firefighters make entry to Exposure Charlie to investigate for fire spread within the warehouse which was being heavily impacted by fire. Hazmat Pumper 85, under the command of S.O. Nick Baker, was deployed to assist protection of Exposure Charlie. Hazmat Pumper 85 was positioned at the entrance to the driveway on the eastern side of Exposure Charlie. Firefighters obtained a water supply for Hazmat Pumper 85 from a street hydrant on Milperra Road and laid a 38 mm protection line along the concourse driveway on the eastern side of Exposure Charlie to an access door at the midpoint of the warehouse. Firefighters used a sledge axe and Halligan tool to gain entry to the warehouse. Under the command of S.O. Baker, firefighters wearing SCBA made entry to Exposure Charlie and discovered the building interior was filled with smoke. Investigations identified embers had ignited an area against the western wall of the warehouse. This spot fire was quickly extinguished by firefighters with the 38 mm protection line. Firefighters conducted a thorough investigation of the interior of the warehouse and did not find any other areas of fire spread.

Firefighters continued to monitor the interior of Exposure Charlie for the remainder of operations. Inspector Easy and S.O. Baker noted the completely open plan warehouse contained a heavy fuel load, consisting of floor to ceiling racking fully stocked with highly combustible vinyl cladding products; uncontrolled fire entry into the warehouse would have resulted in the rapid involvement and total loss of the building and its contents. Duty Commander MS3 (South West) Inspector Dean Emery arrived at the fireground and was tasked by the I.C. to take over as Charlie Sector Commander.

Ladder Platform 21 was directed from staging to the concourse at the front of Exposure Charlie, near the Charlie/Delta corner. Water was supplied to Ladder Platform 21 with two 70 mm lines from CP 64. Senior Firefighter John Mattock operated from the aerial cage, directing the aerial master stream along the Exposure Charlie and Delta walls near the sides of the heavily involved timber yard. The Ladder Platform 21 aerial master stream was protecting the sides of the Charlie and Delta exposures, which were now being heavily impacted by fire. Fire at the Charlie end of the yard was burning back against the wind and beginning to impact the 4.5 metre high "Colorbond" steel panel fence separating the involved timber yard from the Exposure Delta car yard. Paint on the fence panels was beginning to blister, pyrolyze and ignite. Cars were parked close to the fence line. Ladder Platform 21 began to sweep the aerial stream along the Exposure Delta fence line, reducing fire intensity and stopping the imminent ignition and spread of fire to vehicles within Exposure Delta.

The aerial master stream of CAP 47 was able to reach the northern wall of the Exposure Delta office/workshop, extinguishing heavy fire activity that begin to breach through the roof of this building. The aerial streams were able to overlap along the Exposure Delta wall, providing full aerial coverage of the exposure, assisting firefighters working on the ground to ensure fire did not spread into this exposure.

Response Increased to Structure Fire 6th Alarm:

Firefighters working in Charlie Sector were encountering water supply issues. At 1837 hours the response was increased to a Structure Fire 6th Alarm for the provision of additional pumpers to establish a water relay.

Hazmat Operations:

Hazmat Pumper 85 and Heavy Hazmat 85 were initially tasked by the I.C. to conduct water run-off management, atmospheric monitoring and SCBA management and control. Hazmat crews placed booms at the front of the Alpha side driveways to capture contaminant within water run-off. Firefighters identified the local drains led to a stormwater canal approximately one kilometre from the fireground (near Ashford Avenue and Milperra Road). Firefighters placed booms across the drain entrance to the storm water canal. Hazmat crews conduct pH monitoring, obtained water samples and liaised with representatives from the Environmental Protection Authority. Hazmat crews conducted SCBA servicing and air cylinder changes and established firefighter rehabilitation. Hazmat firefighters also provided drinking water to SCBA crews, assisting to manage firefighter rehydration. Hazmat 85 firefighters conducted fireground atmospheric monitoring with Altair air monitoring equipment. Results of the air quality monitoring were provided to the I.C.

Electricity Concerns:

Electricity Authority operators attended the scene and were requested by the I.C. to provide isolation and disconnection of all power to the main fire occupancy and confirm isolation to Exposures Bravo, Charlie and Delta. Electricity Authority operators disconnected the supply main at the pole and following testing/proving, confirmed power was disconnected to the main fire occupancy. Firefighters observed a power pole with mains attached at the mid-point of the main occupancy, that appeared to be a source of a secondary electricity supply. Electricity staff checked mapping, however could not see a pole or power main in the area of the pole. The FRNSW Remotely Piloted Aerial System (RPAS) was used to overfly the area of concern, enabling electricity staff to determine the pole and attached mains were part of the internal consumer main, which was now isolated. Total power isolation for the main fire occupancy was now established and confirmed.

Firefighting Operations Continue:

Firefighters operating hose lines within the yard from the Alpha side entry gates were continuing efforts to stop the fire from spreading to non-involved timber stacks and extinguish fire within the yard where they could. Access within the site was restricted due to the establishment of the Bravo side wall collapse exclusion zone. The fire was becoming deeply established within the timber stacks, particularly the hardwood and was resistant to firefighting streams and extremely difficult to extinguish.

Due to the establishment of the collapse exclusion zone, access to the timber yard was only practical via the southern-most entry gate. SCBA crews from 30, 62, 29 and 73 Stations operated 38 mm and 70 mm attack lines and a ground monitor, directing fire attack streams onto the burning timber stacks. On a number of occasions, the 70 mm line was switched between a handheld branch and a single inlet monitor. Firefighters directed water onto non-involved timber stacks, preventing them from becoming involved in fire, extinguished pockets of smouldering timber and directed attack streams onto heavily involved timber stacks, slowly reducing the intensity of the fire and bringing the fire under control. Firefighters were continually moving attacking lines up and down along the southern access path inside the yard. An attempt was made to attack the burning timber stacks with CAFS (Compressed Air Foam System) Class A foam, however this was found to be ineffective.

At the same time hose crews were operating along the Delta side of the timber yard, the aerial master stream of CAP 47 continued to be directed onto the fire, slowly reducing the intensity of the fire and bringing the fire under control. The aerial stream was able to reach areas of fire within the collapse exclusion zone that could not be accessed by firefighters operating hose lines. As fire intensity reduced, the heavy smoke condition within the timber yard began to diminish. SCBA fire attack crews from 84 and 29 Stations were located in Charlie Sector, working in the one-metre-wide corridor between the main fire occupancy and Exposure Charlie. Firefighters continued to direct cooling streams onto the Exposure Charlie warehouse wall, however were located in an excellent position to direct an attack stream onto fire burning at the Charlie end of the timber yard. The aerial attack from Ladder Platform 21 had greatly reduced fire intensity and extinguished a significant area of fire. Firefighters were able to direct the 38 mm attack stream onto burning pockets of fire within the timber yard, completing extinguishment.

Fire Control Established:

The impact of aerial master streams in operation from the Alpha and Charlie sides of the fire had significantly reduced fire intensity. Firefighters were attacking the fire with handlines on the Alpha, Charlie and Delta sides. The fire was contained and exposures were no longer under threat. As fire intensity continued to diminish, at 1909 hours the I.C. sent a CAN report, stating the fire was contained.

Transfer of Command:

At 1940 hours incident command was transferred to Zone Commander MW2 and Duty Commander ME3 appointed Alpha Sector Commander.

Third Aerial Placed in Operation:

The fire continued to burn amongst timber stacks in the middle of the yard, beyond the reach of the hose crews. Ladder Platform 27 was tasked to attack the timber stacks that continued to burn in the middle of the yard. Ladder Platform 27 positioned on Milperra Road near the front fence of Exposure Delta and was supplied water from Pumper 35 with two 70 mm lines. The aerial crew of Ladder Platform 27 were able to extend the aerial cage over the top of Exposure Delta and direct the aerial master stream onto the timber stacks below, achieving a significant reduction in fire intensity.

Fire Duty Operations:

At the completion of the Ladder Platform 27 aerial attack fire intensity had been significantly reduced within the timber stacks. Operations Officer Inspector Easy noted *"the fire in hardwood timber stacks was particularly stubborn and extremely difficult to extinguish."*

At 2117 hours the I.C. reported fire intensity had been significantly reduced following the operation of Ladder Platform 27, enabling operations to be reduced to a Structure Fire 2nd Alarm. An appliance change-over was then effected and a fire duty put in place. Throughout the course of the night firefighters continued to extinguish deep seated and smouldering fires burning within the timber stacks. By daylight on Wednesday 22nd December only minimal signs of smouldering pockets of fire remained and the fire duty was further reduced to a single pumper. Throughout the day firefighters continued to monitor the site for hidden pockets of fire and re-ignitions within the timber stacks, however no fire was detected. At 1428 hours the last FRNSW appliance (CAFS Pumper 31) departed the fireground.

Incident Outcomes

The following incident outcomes were achieved:

1. All persons located in surrounding exposures under threat were removed to safety and remained safe until the incident was concluded.

2. Exposures under direct threat were protected.

3. Fire spread into Charlie Exposure (a warehouse containing large quantities of combustible vinyl cladding) was extinguished and the warehouse saved.

4. Firefighters removed multiple LPG and acetylene cylinders from the fire's path, preventing hazardous explosions from occurring.

5. The actions of hazmat crews prevented contaminated water run-off from entering the watercourse.

6. A large quantity of timber stock within the timber yard was protected and saved.

7. The fire was contained, controlled and extinguished.

8. Heavily threatened exposures were trading the following day, with minimal disruption to business.

Operational Safety Considerations

Some of the Operational Safety Considerations identified at this incident include the following:

1. The burning timber was producing very high levels of radiant heat. Initial fire attack on the burning timber stacks commenced with an aerial master stream, enabling firefighters to project the stream from the maximum distance, reducing exposure to high levels of radiant heat.

2. All firefighters working inside the timber yard were wearing full structural PPC and SCBA to protect against the high levels of radiant heat produced by the burning timber. The fire was also producing significant quantities of smoke.

3. Firefighters identified a number of pressurised gas cylinders in the fire's path. These were removed to a safe area under the protection of a 38 mm hose line. Removal of the cylinders prevented hazardous BLEVE (Boiling Liquid Expanding Vapour Explosion) events from occurring.

4. Electricity was switched off at the main fire occupancy and surrounding exposures. The electricity authority disconnected and isolated power.

5. Police closed Milperra Road, allowing firefighters to operate safely on the closed section of road.

6. Movement was detected in the pre-cast concrete tilt slab panels of Exposure Bravo. A collapse exclusion zone was established and enforced in the area the wall collapse danger existed.

7. Provision of a 3rd Alarm enabled SCBA crews to be continuously rotated. Firefighters established a rehabilitation area and firefighter decontamination area.

8. A Safety Officer was appointed who worked in conjunction with the Sector Commanders, Operations Officer and Incident Commander to ensure all fireground hazards were identified and relevant control strategies implemented.

9. Firefighters were alert to the dangers of collapsing timber as fire burnt through the timber stacks. Fire attack crews operated from positions away from potential collapsing timber stacks.

Learning Notes

Significant learning notes from this incident include the following:

1. The first arriving I.C. conducted an initial fireground size-up that enabled firefighting priorities to be rapidly established. The I.C. determined that if Exposure Bravo was not protected, the fire would double in size. The initial decision by the I.C. to establish protection of Exposure Bravo was critical in establishing fire containment and preventing the expansion (doubling) of the fire. Protection of Exposure Bravo also bought firefighters some time, as they worked to establish the substantial water supplies needed for the effective operation of CAFS Aerial Pumper 47.

2. Pumper 34 was undertaking a critical task, protecting Exposure Bravo from fire spread. The I.C. made the decision to obtain the water supply for CAP 47 from an alternate water source to the main being used by Pumper 34, to ensure there was no reduction in the water supplies going to Pumper 34, ensuring the crew of Pumper 34 could maintain effective protection of heavily threatened Exposure Bravo.

3. The I.C. quickly determined the most effective way to attack the fire was with an aerial master stream. CAFS Aerial Pumper 47 was positioned in Woorang Street and preparing to go into operation, however a water supply had not been established. Realising the critical importance of establishing a substantial water supply, the I.C. directed incoming crews to remain on Milperra Road and not enter Woorang Street, to assist in the urgent establishment of a water supply for CAP 47 from the Milperra Road main. The next three incoming stations worked closely together, rapidly laying four 70 mm supply lines to CAP 47. The water supply to CAP 47 was excellent and enabled the aerial master stream to attack the fire with a high level of effectiveness, reducing fire intensity, stopping the fire's internal spread, establishing containment and protecting heavily threatened exposures.

4. The decision of the first arriving I.C. to task Technical Rescue 8 with pre-emptively gaining entry and opening all doors to Exposure Delta, to enable the deployment of firefighting hose lines ahead of the fire's impact ensured there was no delay in controlling fire spread into Exposure Delta.

5. Protection of Exposure Charlie was undertaken in a coordinated manner through a combination of external defensive line, aerial attack and internal protection line. Exposure Charlie contained a very high fuel load of combustible materials and was being heavily impacted by the fire. The combined actions of firefighters saved this exposure.

6. Firefighters made a determined effort to limit the internal spread of fire through the yard. The yard contained numerous timber stacks that the fire had not spread to. Firefighters made a determined advance into the yard, wetting down multiple stacks under threat and protecting these from fire spread. As fire attack crews pushed deeper into the yard, a second fire attack crew ensured their exit path was not cut off by fire. These operations saved a large quantity of timber yard, greatly reduced the potential size of the fire and established a barrier between the fire and the western end of Exposure Delta. 7. Fire impact to the Exposure Delta steel Colorbond fence was so severe, the metal fence panels were blistering, pyrolyzing and burning. 75 tightly packed fully fuelled cars were parked just 300 mm from the fence. In a highly coordinated effort, firefighters used a combination of 38 mm hose lines, aerial master streams and a high-pressure water spray cleaner to stop the fire entering Exposure Delta. Firefighters showed initiative and determination. The work of firefighters in Exposure Delta was so successful, the business was trading the next day.

8. Timber yard fires have been historically very problematic for firefighters. Burning timber contains high thermal energy, producing large radiant heat output. Timber yard fires will place nearby exposures under immediate threat, due to the large quantities of "*area source*" radiant heat being produced. It is also not uncommon for airborne burning materials to be released from timber yard fires, potentially threatening exposures downwind of the fire. Establishment of fire control requires large volumes of water, preferably from master streams.

9. The combined effects of wind direction and strength, structural formation and fuel load produced a wind driven fire. Venting flames on the leeward side of the fire were extremely intense. A wind driven fire requires a wind speed of at least 15 km/h to be present. Wind speed at the fireground was 30 km/h with gusts of up 50 km/h recorded.

10. The effects of wind driven fires within structures are well documented, however less is known about the impact of wind driven fires involving outdoor scenarios. A critical element in the development and formation of a wind driven fire is the presence of a hydrocarbonenriched atmosphere where combustion is taking place, "supercharging" the fire. The various hydrocarbon-based materials at the site enabled extremely flammable hydrocarbon-rich pyrolysis gases to be released into the fire combustion zone, producing extreme fire conditions, including the formation of a superheated exhaust gas flow (horizontal venting flame) that impacted the Exposure Bravo second level glass frontage. Firefighters managed to protect Exposure Bravo from this extreme fire impact, which was so severe significant areas of spalling were identified post fire in the concrete wall slabs.

11. Operations to complete final extinguishment at timber yard fires are a major challenge for firefighters. Like many stack and pile fires, significant fire activity is located within the inner core of the stacks. Firefighting to complete extinguishment is often lengthy, arduous and exhausting. This work requires continuous wetting down of the burning timber to prevent re-ignitions from occurring and if possible, removal of timber to reach areas of deep-seated burning. Unfortunately, on-site equipment/heavy machinery was not available to firefighters at Milperra to separate and pull the burning stacks apart and provide access to pockets of deep-seated fire.

12. The fireground tactical and strategic command decision making at this fire cannot be faulted. There were many decisions made by the first arriving Station Officers that had an enormous bearing on the successful firefighting operations and consequent incident outcomes achieved at this incident. Firefighting decisions were based on a number of factors identified during size-up including fire conditions, exposures under threat, water supply and occupancy type involved in fire. Fireground decision making was undertaken in a systematic manner in accordance with incident requirements and objectives.

Conclusion:

When firefighters arrived at the Woorang Street timber yard fire, they were confronted with a difficult fire scenario, involving an expanding fire within stacks of timber producing large quantities of radiant heat. Fire conditions were intensified because of the involvement of volatile hydrocarbon-based products, including fuels, lubricants, cleaning products and other materials used for the servicing and operation of the many machines on site. This already volatile and fierce fire condition was significantly worsened due to the impact of strong winds that greatly increased fire intensity. First arriving firefighters were confronted with an expanding fire and a large volatile fuel load. Multiple exposures were located adjacent to the timber yard and were in significant danger. One exposure was already being impacted by fierce flames and was in severe danger.

The I.C. commenced a systematic, disciplined and precise operation to establish protection of the exposure most heavily under threat. The fire control strategy consisted of attacking the fire with an elevated aerial master stream. While aerial appliance was being prepared for operation, incoming crews were tasked with establishing a water supply that would enable the aerial appliance to work at capacity. Utilising these incoming crews provided the I.C. with an enormous strategic advantage that would enable the critical incident objective of establishing fire control to be effectively achieved, because of the establishment of an adequate water supply. An equally significant strategic advantage was gained when the decision was made to task crews to obtain water for the aerial appliance from a separate main to the main crews were already working from to protect heavily threatened Exposure Bravo. Firefighters were now able to protect an exposure under heavy threat and at the same time conduct an effective aerial master stream attack, without fear of over-running water supply.

The decision to pre-emptively make entry to Exposure Delta allowed firefighters to be fully prepared for any fire impact to this exposure. When the fire did reach Exposure Delta, the weight of attack due to the pre-emptive deployment was able to quickly suppress the fire impact, despite the intensity of the fire attacking Exposure Delta. Similarly, the coordinated operation of an external defensive stream, internal protective line and aerial master stream established for the heavily threatened Exposure Charlie warehouse.

The I.C. established a command structure that was expanded and built out as the incident progressed, seamlessly transitioning command to Duty Commander ME3 and then to Zone Commander MW2. The I.C. built a solid command platform that ensured all crews were working in accordance with the I.C.'s objectives. This enabled a systematic and coordinated approach to firefighting that ensured all incident objectives were achieved. In unison with firefighting operations, fireground safety was a key element of the command structure.

A number of critical factors were in evidence at the Woorang Street fire, including the main fuel load consisting of timber stacks, timber pallets and timber crates and the associated severe fire behaviour associated with this fuel load type, the involvement of volatile hydrocarbon-based materials, the severe impact of wind on fire behaviour and the significant increase in fire intensity associated with wind impact, the involvement of gas cylinders, gas cylinder explosions and the close proximity of multiple exposures to the main fire occupancy. Additionally, this location is well known by firefighters for poor water supplies. The effectiveness of firefighting operations at this fire can be measured by the highly successful incident outcomes. Despite heavy fire threatening and impacting surrounding exposures, all exposures were successfully protected and businesses were trading the next day with minimal disruption. The main fire occupancy was heavily involved in fire when firefighters arrived, nevertheless firefighters managed to save large quantities of timber stock and a number of machines. Firefighters were confronted with a difficult and complex fire scenario at Woorang Street. Fireground commanders established solid fireground strategies and tactics, in accordance with incident conditions, priorities and objectives. Firefighters worked with diligence, determination and professionalism, in challenging conditions. The best possible incident outcomes were achieved. There are many positive lessons to be shared from the very professional FRNSW firefighting operations undertaken at this fire and all crews should be congratulated.



Firefighters faced numerous challenges at Milperra, including a fast-moving fire, high fuel load, fire driven by strong winds and multiple exposures in close proximity to the main fire occupancy.



The Main Fire Occupancy shortly after firefighters arrived on scene. The fire is already at an advanced stage and has breached through the roof above the middle of the yard.



Fanned by strong winds, the fire burns intensely within the timber stacks. Dark coloured smoke is indicative of hydrocarbon-based products stored at the site, including various fuels, cleaning products and lubricants for the numerous machines at the site. Firefighters have established protection of Exposure Bravo which is being impacted by fire.



Conditions resulted in the formation of a wind driven fire. Winds were gusting at almost 50 km/h. A wind entry point existed on the open sided southern end of the structure. Flames vent at the north western corner of the structure, producing a characteristic superheated gas exhaust. The presence of oil-based products in the yard allowed a hydrocarbon-enriched atmosphere to develop in the fire combustion zone, greatly increasing fire intensity. Firefighters encountered ferocious fire conditions.



Key elements of a wind driven fire: **A** Wind Entry Point, on the up-wind side of the structure. Although flame is visible, it is not venting from this opening (being held in by wind pressure). **B.** Fire Vent Point. Large flames are being released from the fire vent point, on the down-wind opening of the structure. Within the structure, extreme levels of combustion take place, due to the pressurised and oxygenated air flow mixing with the hydrocarbon enriched atmosphere. Fire intensity is much greater than would ordinarily be encountered due to these factors. This type of extreme fire behaviour is not common, however can occur on windy days. The flames venting in the bottom photograph are more consistent with flammable vapour ignitions, indicative of the "hydrocarbon-rich" nature of the venting un-burnt pyrolysis gases.

В



The wind driven fire produced intense venting superheated gases, causing the steel to lose tensile strength and twist (**A**) and severe spalling of a pre-cast concrete slab panel (**B**). This damage is indicative of the elevated heat associated with the venting superheated gases produced by a wind driven fire. No where else on the fireground did this level of fire damage occur. Photopgraphs on previous pages 27-30 depict the ferocity of the venting flames.



Dark coloured smoke venting from the timber yard is indicative of the hydrocarbon-based materials present at the site, including fuels, lubricants, cleaning products, etc. Fire activity is intense and multiple exposures are under threat simultaneously. Firefighters are systematically establishing protection on all sides of the main fire occupancy.



Fire activity is ferocious. The iron-sheet roof held a large amount of heat in the fire combustion area, increasing fire intensity. The iron roof sheets acted as a barrier to the application of firefighting water streams.



The site contained machinery used in the manufacturing process. The machinery did not contribute directly to fire behaviour, however fuels, lubricants, degreasers, cleaning products and solvents associated with the manufacturing process resulted in conditions of severe fire behaviour.



Intense fire is impacting the Exposure Charlie wall. Firefighting operations to protect Exposure Charlie were disciplined and coordinated, involving aerial streams, external protection lines and internal firefighting crews. Despite the ferocity of the fire impact, Exposure Charlie was saved.



Exposures Bravo (top and middle) and Charlie were heavily impacted by fire. An important element of firefighting operations was the protection of these exposures. Shortly afer arriving on scene, firefighters established a protection stream onto the second level glass windows of Exposure Bravo. A combination of tactics, including hand line, internal firefighting and aerial streams was used to protected Charlie Exposure. This was extremely professional firefighting. Incredibly, despite the intensity of fire impact, no exposures were



Top Left: CP 64 obtaining water from the booster supply hydrants pumps water via 2 x 70 mm lines to Ladder Platform 21 (middle), protecting exposures Charlie and Delta. Top right and Lower right: Intense fire activity erupts from the yard. Firefighters battled hard to contain the fire to the premises of origin. Lower left: Appliances located on Milperra Road.



Exposure Delta came under heavy threat from impacting fire. The combined efforts of the Ladder Platform 21 aerial crew and firefighters operating hose lines from inside Exposure Delta protected the car rental yard containing almost 80 vehicles. Despite the intensity of the fire impact, Exposure Delta was saved and the business was trading the following day.



Ladder Platform 21 alternated between directing protective streams along the western wall of Exposure Charlie and the northern wall of Exposure Delta. Working closely with hose crews on the ground, these coordinated operations ensured heavily threatened exposures were protected.



Firefighters begin to advance into the timber yard from Alpha Sector, wetting down timber not already involved in fire and extinguishing spot fires and burning timber stacks. These operations saved a significant amount of stock. They also reduced the fire area and created a fire break, stopping the fire from travelling through timber stacks to reach Exposure Delta.



Firefighters protected a large quantity of timber packs and stacked timber, reducing the size of the fire area and creating a fire break that stopped the fire spreading to additional exposures. A truck inside the yard was also saved (lower right). Although the fire represented a major loss for the business owner, there was significant value in the stock firefighters managed to save.



Firefighters begin battled ferocious fire conditions. From the moment the first appliance arrived on scene, firefighters began to establish operations that were coordinated, systematic and disciplined, determined by incident priorities. Firefighters were confronted with an expanding, fast moving and intense fire, threatening multiple exposures. Forklift LPG cylinder explosion (bottom left).



Top left: Firefighters removed a number LPG cylinders out of the fire's path. Several BLEVE (Boiling Liquid Expanding Vapour Explosion) events occurred involving LPG cylinders attached to forklifts. The steel brackets (indicated by arrows) used to secure the cylinders have been severely bent due to the force of the explosion from the LPG cylinders.



The yard, including the caged area, contained significant quantities of hydrocarbon-based materials used for day-to-day operations of the business, including fuels, lubricants and cleaning products. Under fire conditions these materials produce intense and extreme fire conditions.



The yard contained significant quantities of hydrocarbon-based materials used for day-to-day operations of the business, including fuels, lubricants and cleaning products. Under fire conditions these materials produce intense and extreme fire behaviour. In these views, products including 200 litre drums of isopropyl alcohol and gas cylinders containing acetylene.



The aerial appliances did an outstanding job, establishing protection with aerial master streams on all sides of the main fire occupancy and conducting effective direct attack on the fire, reducing fire intensity sufficiently for fire control to be gained; what isn't so obvious is the planning from the initial fireground commanders to establish adequate water supplies from appropriate mains to support the master stream operations. Equally important was the work of firefighters who rapidly established the water supplies. In addition to the great skill of the operators, the aerials were effective because sufficient water supplies were established.



Heavy fire impacts the Exposure Delta office/workshop. Firefighters inside the exposure building extinguished fire as it entered the roof space (initially using a high pressure cleaning spray gun). The aerial stream of CAP 47 sweeps down the wall, extinguishing the fire externally.



Severe fire impact to the roof eaves and fire entry to the roof space of Exposure Delta (indicated by arrows). Firefighters located inside Exposure Delta extinguished the fire as it entered the roof space, stopping fire spread and saving the exposure.



Exposure Charlie is under severe threat from fiercely impacting flames. Firefighters located in a one metre gap between Exposure Delta and Exposure Charlie direct a protective cooling stream onto the wall of Exposure Charlie. This stream is indicated by the arrows. Hose crews worked in conjunction with the aerial crew to protect Exposure Charlie.



CAP 47 initially placed an aerial stream in opertaion with two 70 mm supply lines (top left) providing a fair stream. When a supply was established with four 70 mm lines the aerial stream was greatly improved (upper right and middle), allowing firefighters to conduct an effective attack on the fire, resulting in fire intensity being reduced and fire control being established. Lower: The fire produces heavy black smoke as firefighters establish a water supply for CAP 47.



Top left: Heavy fire activity impacts te Exposure Charlie warehouse. Top right: At the same time, firefighters are laying an attack line, prior to entry being gained into the exposure (lower left), where firefighters extinguished a spot fire and ensured the warehouse remained protected. The I.C. surveys Alpha Sector (lower right).



Top and middle: Firefighters established multiple water relays to supply the aerial appliances. Lower left: CAFS Aerial Pumper 47 and Ladder Platform 21 attack the fire. Lower right: An aerial master stream attacks heavy burning in the middle of the timber yard.



Ladder Platform 21 alternated between directing protective streams along the western wall of Exposure Charlie and the northern wall of Exposure Delta. Working closely with hose crews on the ground, these coordinated operations ensured heavily threatened exposures were protected.



The aerial master stream of CAFS Pumper 47 is directed on the fire, resulting in a significant reduction in fire intensity and establishment of fire control. Firefighters located mains remote to the location of the aerial, ensuring the aerial water supply draw from supplies already being used. The aerial monitor is fitted with stacked tips, creating a solid aerial that was more effective under the windy conditions than a hollow stream from a diffuser spray nozzle. The aerial stream was highly effective.



Upper and middle: Ladder Platform 21 attacks the fire from the Charlie Delta corner. The aerial stream was able to protect heavily threatened Charlie and Delta exposures. Lower: CAFS Aerial Pumper 47 directs an aerial master stream onto the fire, reduicng fire intensity.



An interesting feature of the site were the two overhead gantry cranes located on the north and south sides of the yard, formed from prefabricated rolled steel.